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Determination of Islamic Month Start by *Moonsighting Australia* (Case Study: 1 Dzulhijah 1441)

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Abstract

The determination of the Islamic calendar is paramount in Islam because it strongly relates to worship, like *Ramadan* fasting, *eid-al-fitr*, and *zakat fitr*. Many studies have examined young moon visibility criteria in many Muslim countries, such as Indonesia, Saudi Arabia, Thailand, and Singapore. However, no study on the initiation of the Islamic month has been conducted in Australia, a Muslim-minority country with middle-eastern immigrants seeking jobs. One of Australia's most trusted organizations to announce the start of Hijri month is *Moonsighting Australia*. Therefore, this study aimed to analyze the determination of the Islamic calendar by *Moonsighting Australia* organization based on factors such as method, *matla*, *rukyat* time, *hilāl* visibility, and resistors (1 *Dzulhijjah* 1441 H). A descriptive study with a qualitative approach used literature reviews, content analysis, and case studies. Primary data were taken from a decision letter from *Moonsighting Australia* about the start of *Dzulhijjah* 1441 H, interviews with the coordinator, and relevant references. The findings showed that *Moonsighting Australia* applies a *rukyat* method by the naked eye - without any optical aids and hilāl visibility criteria consideration - every 29th of Hijri month. Also, it tunes the concept of *matla wilayat al hukmi*, where the sighting process and result are implemented throughout Australia's territory.

Keywords: Australia, *Dzulhijjah*, *Hijri*, Islamic Month, Moonsighting.

Introduction

In the past few years, Islamic communities worldwide have increased since being introduced and disseminated by Prophet Muhammad (*SAW*) The Muslim population is estimated at 1.6 M adherents, becoming the second-biggest religion.[1] It has been distributed central to northern Africa, middle-east area, and south-east Asia. Muslim communities account for 90% of Egypt, Afghanistan, Syria, Pakistan, Turkey, and Iran. Indonesia has 231 Muslims, accounting for 13% of the community's population worldwide. Figure 1 describes the distribution of Muslims worldwide.[2]

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[1]D. DeSilver, "World's Muslim Population More Widespread than You Might Think," *Factank*, 2013, http://pewrsr.ch/116QRmk.

[2]World Population Review, "Muslim Population by Country 2021," 2021, https://worldpopulationreview.com/country-rankings/muslim-population-by-country.

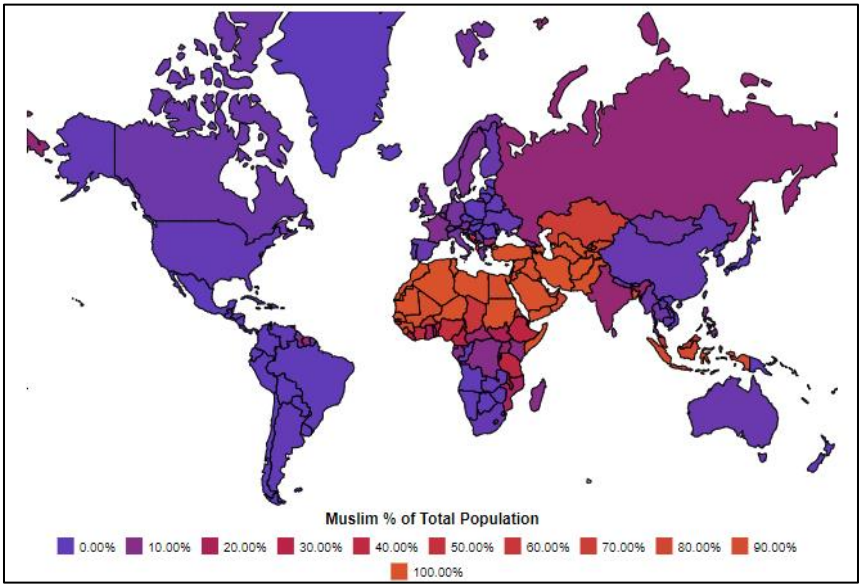

Figure 1. The general description of the Muslim's distribution and portion in the world

Muslim communities are united by a sentence *la ilaha illallah muhammadur Rasulullah*, meaning "The only god is Allah and Muhammad (*SAW*) is Allah's prophet." They are committed to applying Islamic laws in each aspect of their life. The basic obligations include conducting five daily prayers, paying *zakat*, fasting in the month of *Ramadan*, and performing the pilgrimage. Moreover, Muslims perform *Sunnah*, which entails *rawatib*, almsgiving, or *umrah*.

Islam obligates the only validity of worship performed with sincere intentions to Allah and according to the guidance from the Prophet Muhammad (*SAW*).[3] Therefore, every worship has rules related to the procedure, time, and place of implementation. The worship is considered wrong when the procedure is correct while other aspects are inaccurate. Similarly, worship implemented on time and in the correct place is refused when it does not follow the guidance from the Prophet Muhammad (*SAW*).

Worship is considered valid based on the determination of the start of the Islamic month. The fasting of *Ramadan*, *eid-al-fitr*, *Arafah*, and *zakat, fitr* are all examples of specified time-dependent worships. Performing *Ramadan* fasting on the 30th of *Sha'bān* is not warrantable. Also, fasting on the 1st of *Shawwal* and praying *eid-al-fitr* on the 30th of *Ramadan* is not permissible.[4] Similarly, *Zakat-al-fitr* paid outside the month of *Ramadan* or after praying *eid-al-fitr* is only considered almsgiving.[5]

[3]Shalih bin Fauzan bin Abdullah, *At Tauhīd Li Ash- Shaff Al- Awwal Al- 'Ali*, ed. Agus Hasan Bashori (Jakarta: Darul Haq, 2013).

[4]Muḥammad ibn Ismā'īl ibn Ibrāhīm Al-Bukhārī, *Ṣahīh Al-Bukhārī*, Cet. I (al-Qāhirah: Dār ibn al-Jauzī, 2010), Bukhari no. 1907; Abu Husain Muslim bin al-Hajaj bin Muslim al-Qusairi An-Naisaburi, *Al-Jamiu Al-Shahih Al-Muslim* (Lebanon: Maktambah Ilmiyah, n.d.), Hadīth no. 1080.

[5]Abu Muhammad Mahmud bin Ahmad bin Musa Badruddin Al-Aini, *Syarah Sunan Abu Dawud (The Explanation of Sunan Abū Dāwud)* (Riyadh: Maktabah Rasyd, n.d.); Abu Abdullah Muhammad

Studies have examined the urgency to determine the beginning of the Islamic month, which is indicated by the appearance of *hilāl*. In this case, *hilāl* is the first crescent moon that appears after the *ijtima*, the geometric conjunction between the earth and the moon at the same celestial longitude, viewed from the earth.[6] Therefore, the *hilāl* visibility criteria have been the study object by scientists. In 1910, a preliminary study about *hilāl* visibility criteria was released in a reputed international journal.[7] Subsequently, scientific publications on the same topic emerged written by Ilyas, Odeh, Sultan, Ahmed[8] etc.[9]

The determination and implementation of the start of the Islamic month's uses different methods and criteria. The decisions of Muslim-majority countries such as Saudi Arabia,[10] Turkey,[11] and Indonesia,[12] are officially managed by the government. In contrast, minority countries are established by local Islamic organizations such as Thailand [13] and Singapore.[14]

Australia is one of the countries with a significant number of Muslims, reaching 604,200 or 2.6% of its population. Although it seems as a minority, Islam is the second biggest religion in Australia after Christianity. The outset of contact with Islam occurred around 1750 when fishers from

bin Yazid Ar-Rabi' bin Majah Al-Qazwini, *Sunan Ibn-e-Majah*, ed. terj. Iqbal dan Mukhlis (Jakarta: Pustaka Azzam, 2005).

[6]Abu Yazid Raisal, "Berbagai Konsep Hilal Di Indonesia (Various Hilāl Concepts in Indonesia)," *Al-Marshad: Jurnal Astronomi Islam Dan Ilmu-Ilmu Berkaitan* 4, no. 2 (December 20, 2018): 146–55, https://doi.org/10.30596/jam.v4i2.2478.

[7]John Knight Fotheringham, "On the Smallest Visible Phase of the Moon," *Monthly Notices of the Royal Astronomical Society* 70 (1910): 527.

[8]Ahmed Kamil Ahmed, and Abdul Halim Abdul Aziz, "Young Moon Visibility Criterion Based on Crescent Illumination and Sky Brightness Contrast Model," *Middle-East Journal of Scientific Research* 21, no. 9 (2014): 1616-41; Mohammad Ilyas, "Limiting Altitude Separation in the New Moon's First Visibility Criterion," *Astronomy and Astrophysics* 206 (1988): 133-35; Mohammad Sh Odeh, "New Criterion for Lunar Crescent Visibility," *Experimental Astronomy* 18, no. 1-3 (December 29, 2004): 39-64, https://doi.org/10.1007/s10686-005-9002-5; A. H. Sultan, "The Length of the New Crescent Moon," *The Observatory* 125 (2005): 227-31.

[9]Nazhatulshima Ahmad et al., "A New Crescent Moon Visibility Criteria Using Circular Regression Model: A Case Study of Teluk Kemang, Malaysia," *Sains Malaysiana* 49, no. 4 (2020): 859-70.

[10]Zaki A Al-Mostafa, "Lunar Calendars: The New Saudi Arabian Criterion," *The Observatory* 125 (2005): 25–30.

[11]Bulent Gencer, "Sighting of Crescent by Communicated Tradition and Mental Proofs," *Turkey Calendar Time Calculating Directorate*, 2016, http://www.islamicalendar.co.uk/pdf/HilalKongreEN.pdf.

[12]Ahmad Wahidi et al., "Implementation of the Mabims Criteria in Determining the Beginning of Islamic Month in Indonesia and Brunei Darussalam," in *Proceedings of the International Conference on Engineering, Technology and Social Science (ICONETOS 2020)*, 2021, 96-108, https://doi.org/10.2991/assehr.k.210421.016.

[13]Nur Aida Athirah Sulaiman, and Shahir Akram Hassan, "The Application of Rukyah and Hisab in Determining the Starting Dates of the Months of Ramadhan and Syawal in Thailand," *International Journal of Academic Research in Business and Social Sciences* 8, no. 4 (2018): 788-802.

[14]Mohd Shukri Hanapi, and Shahir Akram Hassan, "Basis for Using the Rukyah Method for Determining the Arrival of Ramadan and Syawal in Brunei Darussalam," *Journal of Islamic Studies* 3, no. 2 (2015): 13-22.

South Sulawesi, Indonesia, interacted with Australian residents in the North. This was followed by the appearance of Afghanistan immigrants that settled in Australia.[15]

Hundreds of thousands of Muslims living in Australia are bounded by *sharī'ah* obligations, such as the urgency of determining the beginning of Islamic month in the worship practice. However, there is no study on the *hijri* month determination. Therefore, the close distance between Australia and Muslim-majority Countries (Indonesia, Malaysia, and Brunei), as well as the Middle-East immigrants' existence, makes it a more vital and appealing topic.

As a Muslim minority country, determining the beginning of the Islamic month is not facilitated by Australia. However, it is announced by the local Islamic organizations. A previous study found that the two Islamic organizations trusted to determine the Islamic month start are *Moonsighting Australia* and *Australian National Imam Council.*[16] This study only focused on *the Moonsighting Australia* organization. It aimed to analyze the determination of the Islamic calendar by *Moonsighting Australia* organization based on the method, *matla*, *rukyat* time, *hilal* visibility, and resistors (1 Dzulhijjah 1441 H).

2. Methodology

This descriptive study represented the phenomena and characterization[17] using a quantitative approach to library research, content analysis, and case studies. The library research used literature resources to obtain data,[18] while the content analysis involved a systematic explanation of quantitative data.[19] Furthermore, the case study was used to develop a hypothesis for further exploration.[20]

Primary data were obtained from a decree determining 1 Dzulhijjah 1441 H issued by *Moonsighting Australia*[21] and interviews with the *Moonsighting Australia* organization coordinator. The study also collected some *hilāl* and computed them using software based on accurate times.[22] Moreover, secondary data were obtained from national and international books, websites, and previous works through documentation and analysis of relevant questions to theory. The data collected were analyzed by a comparative approach.[23]

[15]Riaz Hassan, *Australian Muslims: The Challenge of Islamophobia and Social Distance* (International Centre for Muslim and non-Muslim Understanding, University of South Australia, 2018).

[16]"Australian National Imam Council," Uniting the Imams and Community of Australia, n.d., https://www.anic.org.au/.

[17]M. Gall, Joyace Gall, Walter Borg, *Educational Research: An Introduction*, 8th ed. (Boston: Pearson, 2007).

[18]Thomas Mann, *The Oxford Guide to Library Research* (Oxford University Press, 2015).

[19]Margrit Schreier, *Qualitative Content Analysis in Practice* (Sage publications, 2012).

[20]Robert K Yin, *Applications of Case Study Research* (Sage, 2011).

[21]Moonsigthing Australia, "Dhul Hijjah 1441 – Hilal Has Not Been Sighted Anywhere in Australia. Therefore, the Month of Dhul Hijjah Will Commence from Thursday, 23rd of July 2020," Moonsigthing Australia, 2020, https://moonsightingaustralia.info/2020/07/.

[22]Mohammad Odeh, "Accurate Times," *International Astronomical Center, n.d., https://www.astronomycenter.net/accut.html?l=en.*

[23]Patrick A. Mello, *Qualitative Comparative Analysis: An Introduction to Research Design and Application* (Georgetown University Press, 2021).

3. The *Moonsighting Australia*

The official website of *Moonsighting Australia* indicates that this organization's establishment was driven by a worry about the irregular practice of the Islamic calendar and society's misperceptions regarding astronomical calculations. The beginning of the *hijri* month was determined before the conjunction, impacting *Eid-al-Fitr* and *Eid-al-Adha*.

In 1996, the first congress among representative clerics from Australian states was held in Rooty Hill Mosque, Sydney. After a long discussion, a *Moonsighting Australia* organization was formed, chaired by Dr Shabbir Ahmad. More than 50 clerics from various states and territories of Australia joined the organization a year after. In 2018, over 100 clerics from the entire territories of Australia joined the organization. [24]

Moonsighting Australia is supported by the members of the Australian Ulema Council, such as Maulana Ridwan Rafi, Maulana Shamim, Mufti Naeem Ali, Sheikh Abdul Moez Nafti, Sheikh Fadi Baba, Mufti Amjad Iqbal, and Maulana Mohammed Amin. Other members are Maulana Dr. Abdul Karim, Sheikh Tariq, Maulana Hafiz Gulam Ali, Mufti Muneeb, Maulana Imran Hussain, Maulana Shahzad Khan, Maulana Uzair Akbar, and Sheikh Burhan. Furthermore, the organization is supported by Australian National Imams Council (ANIC), and some became members. The organization is the most trustworthy resource for information about *Rukyatul Hilāl* in Australia. It comprises more than 100 *imams*, mosques, and Islamic Centers in Australia.[25]

4. Analysis of Determining the start of *Dzulhijjah* 1442 H by *Moonsighting Australia*

4.1 Analysis Method

The beginning of the Islamic month could be determined through observation (*rukyat*) and calculation (*hisāb*). The *rukyat* method involves observing the crescent directly on the 29th day (30th night) of the Hijri month. When the *hilāl* is visible, it means the next month has started, but it is summed up to 30 days when *the hilāl* fails to appear, and a new month starts on the next night. The *hisāb* method determines certain astronomical criteria to stipulate the beginning of a *hijri* month without observing the *hilal*. The night is declared the start of the next month when the astronomical criteria are fulfilled by the 29th day (30th night). The failure to meet the criteria means the next month is declared to start on the next night, and a month is summed up to 30 days.[26]

The *rukyat* method also entails observing a new moon or *hilāl* at the end of *Shaban* and *Ramadan* month by testimony and report of two righteous people to the judge. This definition covers three aspects. First, the visible *hilāl* after the sunset of the 29th of *Shaaban* and *Ramadan* is used to determine the beginning of *Ramadan* and *Shawwal*. Second, one or two righteous people must witness the *hilāl*. Third, they must report their observation to the judge.[27] Rohmah stated that the *rukyatul hilāl* is performed in conjunction with the moon, earth, and sunset.[28]

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[24]Australia, "Dhul Hijjah 1441 – Hilal Has Not Been Sighted Anywhere in Australia. Therefore, the Month of Dhul Hijjah Will Commence from Thursday, 23rd of July 2020."

[25]Moonsighting Australia, "Members," 2022, https://moonsightingaustralia.info/members/.

[26]Jaenal Arifin, "Fiqih Hisab Rukyah Di Indonesia: Telaah Sistem Penetapan Awal Bulan Qamariyyah) (Fiqh Hisab Rukyah in Indonesia: Study the System of Determining the Beginning of the Qamariyyah Month)," *YUDISIA: Jurnal Pemikiran Hukum Dan Hukum Islam* 5, no. 2 (2016).

[27]Wahbah Al-Zuhayli, *Al-Fiqh Al-Syafi'iy Al-Muyassar*, Vol I (Jakarta: Penerbit Almahira, n.d.).

[28]Nihayatur Rohmah, "Ijtimak Sebagai Prasarat Pergantian Bulan Baru Dalam Kalender Hijriyah: Studi Analisis Ijtimak Awal Bulan Syawwal 1441 H) (Ijtima' as a Prerequisite for the New

Verse 185 in Qur'ān, Al-Baqarah is the basis of the *rukyatul hilāl* application, where a person must fast the following day after observing the *hilāl*. Due to the existence of the word "*shahida*," which means "witness," Ibn Kathīr concluded this verse to command the *rukyatul hilāl* application for determining the beginning of *hijri* month.[29] Moreover, *hadīth* from Prophet (*SAW*) give directions on this method application on determining the beginning of Ramadan and *Shawwal*. The Prophet Muhammad (*SAW*) said,[30]

لاَ تَصُوْمُوْا حَتَّى تَرَوْا الِهلاَلَ وَلاَ تُفْطِرُوْا حَتَّى تَرَوْهُ ، فَإِنْ غُمَّ عليكم فأكملوا العدة ثلاثين

Means: "Do not fast until you see the new moon. Do not break your fast until you see the new moon. If the new moon is covered by a cloud, then complete the month to thirty days."[31]

These *hadīths* direct young moon observation for deciding the first of *Ramadan* and *Shawwal*. They were applied by Imam Shafi'i to command righteous people to apply *rukyatul hilāl* and determine the beginning of *Ramadan* and *Zulhijjah*.[32]

Hisāb is another method for establishing the start of an Islamic month. Abu Sabda transcribed *hisāb* linguistically as a method of calculating the visibility of *the hilāl*.[33] When the *hisab* criteria are fulfilled on the 29th day, that night is the first of the new Islamic month. However, the current month is summed up to 30 days and the next month begins on the next night when the criteria are not met.

There are several well-known calculation methods, such as *Úrfi hisāb*, *hakiki hisāb*, and contemporary *hisāb* methods.[34] Sabda redefined *Úrfi hisāb* as the calculation of the beginning of the month based on its age or habit basis.[35] This method involves taking the average time of the moon to revolve around the earth. The Contemporary *hisab* is the calculation of the sky objects based on the actual motion. In its application, some people used the actual calculation while others calculated the average motion. *Hakiki hisāb* is the calculation of the positions of the sky objects depending on their actual motion and thousands of correction terms for a more accurate result.[36]

Some scholars supported the application of *hisāb* due to its higher accuracy in determining the start of the Islamic month. It is based on Qur'ān chapter Yusuf verse 5 about *manzilahs* that Allah has created and chapter Ar-Rahman verse 5 about calculating the moon and the sun's cycle. *Hisāb* is also based on *hadith*, where the Prophet (*SAW*) discussed the *ummi*, referring to people that could not read or write. The Prophet Muhammad (*SAW*) said,

إِنَّا أُمَّةٌ أُمِّيَّةٌ، لَا نَكْتُبُ وَلَا نَحْسُبُ، الشَّهْرُ هكذا هكذا يعني مرة تسعة وعشرين، ومرة ثلاثين

Moon in the Hijri Calendar: Ijtima' Analysis Study at the Beginning of Shawwal 1441 H))," *AL-MIKRAJ: Jurnal Studi Islam Dan Humaniora (E-ISSN: 2745-4584)* 1, no. 1 (2020): 78-87.

[29]al-Hafiz Abi al-Fida Isma'il al-Qursyiy al-Dimasyqiy Ibn Kathir, *Tafsīr Al-Qur'ān Al-'Azīm* (Beirut, Lubnan: Dar al-Ma'rifah, 1992).

[30]Abū 'Abdillāh Muḥammad bin Ismā'īl Al-Bukhārī, *Ṣaḥīḥ Al-Bukhārī* (Dimasyq: Dār Ibnu Kaṡīr, 1993).

[31]*Ṣaḥīḥ al-Bukhārī*, 2/674: 1807.

[32]Muhammad bin Idris Al-Syafi'iy, *Al-Umm*, Vol 3 (Kaherah, Mesir: Dar al-Wafa', 2001).

[33]A. Sabda, *Ilmu Falak, Rumusan Syar'i Dan Astronomi* [Astronomy, Shar'i Formulation], 2nd ed. (Bandung: Persis Pers, 2019).

[34]Arifin, "Fiqih Hisab Rukyah Di Indonesia: Telaah Sistem Penetapan Awal Bulan Qamariyyah," [Fiqh Hisāb Rukyah in Indonesia: Study the System of Determining the Beginning of the Qamariyyah Month].

[35]Sabda, *Ilmu Falak, Rumusan Syar'i Dan Astronomi (Astronomy, Shar'i Formulation)*.

[36]Ibid.

Means: "Indeed, we are the *ummiyah* people. We do not know the *kitābah* (writing) nor do we know reckoning (*ḥisāb*). The month is like this (he signifies with the number 29) and like this (he signifies with the number 30)."[37]

Consequently, some *hadiths* scholars supported the calculation method and adopted *rukyatul hilāl* due to society's inability to calculate the celestial motion.[38] The decree for determining the 1st of Dzulhijjah 1441 H by the *Moonsighting Australia* organization states that on July 21st, 2020, *hilāl* was not visible in Australia.[39] Therefore, following the guidance of the Prophet Muhammad (*SAW*), the 1st of *Dzulhijjah* would start on July 23rd, 2020, and *Eid-al-Adha* would fall on August 1st, 2020.

Moonsighting Australia, the *rukyatul hilāl* method in determining 1st of Dzulhijjah is based on the visibility of the first crescent. This decision was taken because of the unseen *hilal*, meaning *Zulkaedah* was completed in 30 days, and the 1st of Dzulhijjah fell on the next night on July 23rd, 2020.

4.2 *Matla* Analysis

Analysis of *Moonsighting Australia*'s decree on determining the 1st of *Dzulhijjah* illustrates the *matla* concept believed by the organization. *Maṭlā' hilāl* is placed in certain areas to observe the visibility of *hilal* on the horizon after sunset to start the beginning of the Islamic month.[40] This concept is the basis of the availability of Islamic month determination.

Matla's scope is the observer's eastern area determined from the calculation of the earth's rotational speed, the moon's evolution around the earth, and the sun's apparent speed around the earth per year. The higher the crescent moon, the farther the *matla* boundary is to the east of the observer. According to Fiqh, *Matla*'s scope has four perspectives, including the difference of 1) 88,704-kilometers distance; 2) climate; 3) *matla hilal*; 4) *wilayat al hukmi*, implying *rukyatul hilal* based on the country's territory.

The *Matla*'s scope used by *Moonsighting Australia* organization is the fourth in *Fiqh* perspective of *wilayat al hukmi*. The process and result of *rukyatul hilāl* are only used in Australian territory. Although Indonesia, which is only 488 km from outer Christmas Island in Australia, [41] views the *hilāl*, the result cannot be applied to determine the beginning of *Dzulhijjah* in Australia. *Hilāl*'s rising location is different between Perth and Sydney. At a distance of 3,290.45 km, Perth successfully sights the *hilal*, but the result legitimizes Sydney and Australia to start fasting in *Ramadhan*.

Akhyar stated that *rukyat* has global and local methods.[42] The Global method determined the start of the Islamic month based on sighted *hilāl* in a certain place and applied worldwide. The local

[37]Al-Bukhārī, *Ṣaḥīḥ al-Bukhārī*, 2/675: 1814.

[38]Ali Imron, "Pemaknaan Hadis-Hadis Hisab-Rukyat Muhammadiyah Dan Kontroversi Yang Melingkupinya," [The Meaning of Hisab-Rukyat Muhammadiyah Hadiths and Controversy Surrounding Them], *Jurnal Studi Ilmu-Ilmu Al-Qur'an Dan Hadis* 15, no. 1 (January 13, 2014): 1–22, https://doi.org/10.14421/qh.2014.1501-01.

[39]Australia, "Dhul Hijjah 1441 – Hilal Has Not Been Sighted Anywhere in Australia. Therefore, the Month of Dhul Hijjah Will Commence from Thursday, 23rd of July 2020."

[40]Abd. Salam Nawawi, *Rukyat Hisab Di Kalangan NU-Muhammadiyah* [Rukyat Hisab Among NU-Muhammadiyah]. (Surabaya: Diantama, 2004).

[41]"Distance from Christmas Island to Jakarta," www.distancefromto.net, 2022, https://www.distancefromto.net/distance-from-christmas-island-to-jakarta-id.

[42]Andi Muh Akhyar, "Optimasi Kriteria Kalender Islam Terpadu Berdasarkan Posisi Matahari Dan Bulan Menggunakan Algoritma Meeus (Optimization of Integrated Islamic Calendar Criteria

rukyat is based on moon visibility in a certain place and only applied on that territory (the *Matla'*s scope).[43]

The *Moonsighting Australia* organization's determination is based only on the sighted *hilāl* in Australia. It does not consider sighted *hilāl* in other countries such as Indonesia through https://www.instagram.com/p/CC5tj8hMa8p/. Therefore, *Moonsighting* Australia organization applies the local *rukyat*.[44]

4.3 *Rukyat* Time Analysis

The Prophet (*SAW*) stated that a month has 29 or 30 days. When *hilal* is seen on the 29th day, the next month starts on that night, or otherwise summed up to 30 days.[45] Therefore, *rukyatul hilāl* is always conducted on the 29th day of the *hijri* month. Based on the decree, *rukyatul hilāl* was conducted on Monday, July 21st 2020, because *the Moonsighting* Australia organization believed that day was *Zulqada* 29th, 1441H. The accurate times software showed that the conjunction occurred at 03:31 Australian time (Sydney) on that day.

Assuming *Zulqaada* 29th 1441H was on July 21st 2020, then the *Zulqaada* 1st 1441H determined by the *Moonsighting* Australia organization fell on June 23rd 2020. This was consistent with the decree by the organization about *Zulqaada* 1st 1441H determination written on its website.[46] Its observation on June 22nd 2020, for determining the beginning of *Zulqaada* 1441H could be assumed to be *Shawwal* 29th 1441H. This was consistent with the determination of *Shawwal* 1st 1441H, which fell on May 23rd 2020.[47]

The accurate times software application showed that the conjunction happened on June 21st 2020, at 16.41 Australian time for the month of *Zulqaada.* This means conjunction was not a benchmark for applying *rukyatul hilāl* because the observation was done one day later. The finding confirms *Moonsighting* Australia's choice of the *rukyatul hilāl* method.

It is important to investigate whether *rukyatul hilāl* implementation timing is practised every month. Islamic organizations apply different methods to determine the beginning of the *hijri* months. For instance, the government of Brunei Darussalam only implemented *rukyatul hilāl*.[48] Others use *the hisab* technique as implemented by the Islamic Society of North America (ISNA).[49] Moreover, some organizations combine both methods, such as those implemented by Indonesia. The start of

Based on the Position of the Sun and Moon Using the Meeus Algorithm)" (Universitas Gadjah Mada, 2015).

[43]Ibid.

[44]Lapan Kupang, "Pengamatan Hilal Awal Dzulhijjah 1441 H/21 Juli 2020 (Early Hilal Observation Dzulhijjah 1441 H/21 July 2020)," 2020, https://www.instagram.com/p/CC5tj8hMa8p/.

[45]Ahmad bin Muhammad ibn Hanbal Al-Syaibany, *Al-Musnad Ibn Al-Hanbal* (Lebanon: Dar al-Hadis, n.d.), Hadīth 1881; Muḥammad ibn 'Īsā Al-Tirmidẓī, "Sunan Al-Tirmiẓī," Cet. II (Mesir: Syarikah Maktabah wa Maṭba'ah Musṭafā al-Bābī al-Ḥalabī, 1973), Hadīth 620.

[46]Australia, "Dhul Hijjah 1441 – Hilal Has Not Been Sighted Anywhere in Australia. Therefore, the Month of Dhul Hijjah Will Commence from Thursday, 23rd of July 2020."

[47]Moonsighting Australia, "Statement: Shawwaal 1441/2020," Moonsighting Australia, accessed May 25, 2020, https://web.facebook.com/moonsightingau/photos/2615834702005879.

[48]Hanapi and Hassan, "Basis for Using the Rukyah Method for Determining the Arrival of Ramadan and Syawal in Brunei Darussalam."

[49]Tono Saksono, "Astronomical Calculation as a Foundation to Unify International Muslim Calendar: A Science Perspective," in *Makalah Pada International Symposium: Towards the Unified International Muslim Calendar, Hotel Sahid Jakarta*, (2007): 1–15.

months regarding eminent worship of Muslims, including *Ramadan*, *Shawwal*, and *Zulhijjah*, is determined by *rukyatul hilāl*. Other months are established by *hisab* through MABIMS criteria [50].

The ending of Zulhijjah's decree announced by the *Moonsighting Australia* organization has information about the beginning of other *hijri* months on its official website https://*Moonsighting* australia.info/. This site provides a list of openings of *hijri* month's determination since June 2016 and is updated every month. As a result, *Moonsighting Australia* continuously implemented *rukyatul hilāl* on the determination of every *hijri* month. This matter is also strengthened in the book of *Policy and Procedures: Hilāl Sighting and Decisions*, that the start of every Islamic month must be determined by *rukyatul hilāl*, not only on *Ramadan*, *Shawwal*, and *Dzulhijjah*.[51]

4.4 *Hilāl* Visibility Analysis

The following parameters could be used as *hilal* visibility criteria according to Odeh:[52] Furthermore, ARV-ARCL-DAZ geometry is depicted in Figure 2.

Table 1. *Hilāl* Visibility Criterion and its Definition

Criteria	Definition
Moon age (age)	The time interval between conjunction and observation
lag time (*Lag*)	The time interval between the setting and rising of the sun and the moon
Altitude (Alt)	The angular distance between the moon and the horizon
Elongation (ARCL)	Arc distance between the sun and the moon
Arc of vision (ARCV)	Relative altitude between the sun and the moon
Relative azimuth (DAZ)	Relative azimuth difference between the sun and the moon
width (W)	Width of the lighted area along the moon's diameter

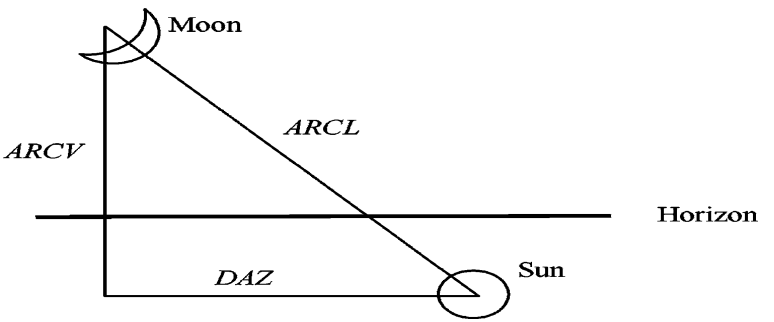

Figure 2. Fundamental geometry variable to predict hilal visibility

[50]Wahidi et al., "Implementation of the Mabims Criteria in Determining the Beginning of Islamic Month in Indonesia and Brunei Darussalam."

[51]Moonsighting Australia, "Policy and Procedures: Hilāl Sighting and Decisions," www.moonsightingaustralia.info, 2018, https://www.moonsightingaustralia.info/wp-documents/Moonsighting Policy.pdf.

[52]Odeh, "New Criterion for Lunar Crescent Visibility."

Odeh has collected around 737 *hilāl* observations worldwide from his studies and by Schaefer, Doggett and Schaefer, and the SAAO list.[53] Data were also obtained by private communication with Jim Stamm, Mohsen Mirsaeed, and Alireza Mehrani. Based on those results, *hilāl* visibility was formulated based on the topocentric altitude difference between the sun and moon (ARCV) and the topocentric *hilāl* width (W). The best time calculation was considered to implement *rukyatul hilāl* (T_b), where T_b is the function for the setting time of the sun (T_s) and moon lag time (lag)[54]:

$T_b = T_s + (4/9)\ Lag$ (1)

Hilāl's observable areas are divided into three zones.

Table 2. Classification of Hilal Visibility Zones by Odeh [55]

Zone	Comparison	Description
A	*ARCV* ≥ *ARCV3*	visible by naked eyes
B	*ARCV* ≥ *ARCV2*	visible by naked eyes/optical aid
C	*ARCV* ≥ *ARCV1*	visible by optic aid

The parameters are illustrated in Table 3.

Table 3. Parameter Relation between Arch of Vision (ARCV) and Moon Width (W)

W	0.1^J	0.2^J	0.3^J	0.4^J	0.5^J	0.6^J	0.7^J	0.8^J	0.9^J
ARCV1	5.6°	5.0°	4.4°	3.8°	3.2°	2.7°	2.1°	1.6°	1.0°
ARCV2	8.5°	7.9°	7.3°	6.7°	6.2°	5.6°	5.1°	4.5°	4.0°
ARCV3	12.2°	11.6°	11.0°	10.4°	9.8°	9.3°	8.7°	8.2°	7.6°

This study applied accurate times software to calculate the astronomical data of the sun and moon in Australia on the observation day. Five geographic representation cities were selected, including north, south, east, west, and central, as well as Sydney as the capital. Table 4 shows the Arch of vision (ARCV) and width of *hilal* compared with Odeh's visibility criterion.

Table 4. Comparison of ARCV and W Data with Odeh's Criteria

City	Longitude	Description	Latitude	ARCV	W	Odeh's Criterion
Sydney	151:11:00	Capital City	33:57:00	+04°:31':18" (04.5°)	+00°:00':08" (0.13')	ineligible

[53]John A. R. Caldwell, and C David Laney, "First Visibility of the Lunar Crescent," *African Skies* 5 (2000): 15; LeRoy E. Doggett, and Bradley E Schaefer, "Lunar Crescent Visibility," *Icarus* 107, no. 2 (1994): 388-403, https://doi.org/https://doi.org/10.1006/icar.1994.1031; Odeh, "New Criterion for Lunar Crescent Visibility"; Bradley E Schaefer, "Visibility of the Lunar Crescent," *Quarterly Journal of the Royal Astronomical Society* 29 (1988): 511-23; Bradley E Schaefer, "Lunar Crescent Visibility," *Quarterly Journal of the Royal Astronomical Society* 37 (1996): 759.

[54]B. D. Yallop, "A Method for Predicting the First Sighting of the New Crescent Moon," *RGO NAO Technical Note*, no. 69 (1997).

[55]Odeh, "New Criterion for Lunar Crescent Visibility."

City	Longitude	Description	Latitude	ARCV	W	Odeh's Criterion
Darwin	130:52:00	North	12:25:00	+07°:30':20" (07.5°)	+00°:00':10" (0.16')	Zone C
Adelaide	138:32:00	South	34:57:00	+04°:48':19" (04.8°)	+00°:00':09" (0.15')	ineligible
Brisbane	152:59:34.9	East	27:19:29.7	+05°:16':28" (05.3°)	+00°:00':08" (0.13')	ineligible
Perth	115:58:00	West	31:56:00	+05°:58':32" (06.0°)	+00°:00':11" (0.18')	Zone C
Alice Spring	133:53:00	Central	23:48:00	+06°:20':41" (06.3°)	+00°:00':09" (0.16')	Zone C

Three of seven *hilal* counted cities qualified with Odeh's criterion for Zone C, including Alice Spring, Perth, and Darwin. Zone C is where the height of the *hilal* is low and only visible using optic aid. Table 4 shows the moon's altitude in three areas is between 6-7.5 degrees.

Based on Odeh's *hilal* visibility calculation, the crescent should be seen in the north, west, and central areas, but *Moonsighting Australia* announced otherwise. Some cities represent every state and geographic area of Australia, including Alice Springs, Darwin, Adelaide, Brisbane, and Sydney. This finding reasserts *Moonsighting Australia*'s position to use the observation method regardless of crescent visibility criteria.

4.5 *Hilal* Visibility Resistor Analysis

Some factors could resist the visibility of *hilāl*, becoming a multi-discipline problem concerning astronomy, meteorology physiology, and optic.[56]

4.5.1Observer Physiology Analysis

Physiology is a part of biology related to the functions of life support, organism process, and its parts.[57] Regarding *hilal* observation, observer physiology relates to their vision of *rukyatul hilāl*. Ahmed and Halim stated that the physiology variable of vision contributes to the observing result's difference.[58] Observer's quality is included in subjective error because *hilāl* observing is a physical and physiological process. The beam of *hilal* illumination arriving at an observer's eyes is transferred to the brain, which continues a perception process from the object received by the human eye depending on prior knowledge and *hilāl* experience. Therefore, observing experience, theory, and

[56]Roy E. Hoffman, "Observing the New Moon," *Monthly Notices of the Royal Astronomical Society* 340, no. 3 (2003): 1039-51, https://doi.org/https://doi.org/10.1046/j.1365-8711.2003.06382.x.

[57]Nature Portofolio, "Physiology," accessed August 28, 2021, https://www.nature.com/subjects/physiology.

[58]Ahmed and Aziz, "Young Moon Visibility Criterion Based on Crescent Illumination and Sky Brightness Contrast Model."

perception impact *hilal* visibility outcomes. In this context, high observation quality is obligatory to get an effective and objective result.[59]

Considering this institution's track record of observing *hilāl* since 1996, it is impossible for the observer's physiology to cause unseen *hilāl*. Moreover, reports on unseen *hilāl* came from all areas in Australia and were written on the announcement declared by *Moonsighting* Australia.[60]

4.5.2Meteorology Analysis

Meteorology is the most popular knowledge for discussing weather and climate.[61] Its effect could also become one of the *hilal* visibility resistor factors. Consequently, the earth cycles around the sun, producing four subtropics seasons. The northern hemisphere witnesses the summer season from December to February and the fall season from March to May. Winter and spring seasons occur from June until August and September until November, respectively.[62]

On 29th July 2020, the *rukyatul hilāl* was conducted in Australia, which coincided with the winter. Most parts of Australia were foggy, frozen, or even snowed.[63] The natural conditions caused difficulties in monitoring the new moon in most parts of Australia. Therefore, one major inhibiting factor for the crescent visibility in Australia for *Dzulhijah* 1441H was the climatic conditions caused by the winter season.

The only dry area in the winter season is the northern region, such as Darwin. [64] July is characterized by high temperatures between 19.3 – 30.6 degrees Celsius. Humidity is also the lowest throughout the year, at 37%, accompanied by the lowest rainfall. During the day, the average sunshine is 10.1 hours.[65] These conditions are ideal for monitoring the new moon, but Darwin et al. does not report moon sightings.[66]

4.5.3 Optic Device Analysis

The optical devices commonly utilized to observe the new moon are cameras and telescopes.[67] This section analyzes the optical instruments used by Australian *Moonsighting* observers. The analysis started by checking the book *Policy and Procedures: Hilāl Sighting and Decisions,* published by *Moonsighting Australia*. The book confirms that a valid *rukyat* report is observed with the naked eye without optic aid.[68] This finding supports the statement by the *Moonsighting Australia*

[59]Muhammad Faishol Amin, "Ketajaman Mata Dalam Kriteria Visibilitas Hilal (Sharpness of the Eye in the New Crescent Visibility Criteria)," *Al-Marshad: Jurnal Astronomi Islam Dan Ilmu-Ilmu Berkaitan* 3, no. 2 (2017), https://doi.org/http://dx.doi.org/10.30596%2Fjam.v3i2.1526.

[60]Australia, "Dhul Hijjah 1441 – Hilal Has Not Been Sighted Anywhere in Australia. Therefore, the Month of Dhul Hijjah Will Commence from Thursday, 23rd of July 2020."

[61]Steven Ackerman, and John Knox, *Meteorology* (Jones and Bartlett Publishers, 2011).

[62]Australia.com, "Australia's Seasons," 2020, https://www.australia.com/en/facts-and-planning/australias-seasons.html.

[63]Georgie Burgess, "'Like a Living Creature': Winter Fog Is Quite a Sight, but What Causes It and When Is It Just Mist?," ABC News, 2021, https://www.abc.net.au/news/2020-06-21/what-causes-fog-and-mist/12358992.

[64]Australia.com, "Australia's Seasons."

[65]"Australia in Spring 2021," Meteorology, Bureau of, 2021, http://www.bom.gov.au/climate/current/season/aus/summary.shtml.

[66]Australia, "Dhul Hijjah 1441 – Hilal Has Not Been Sighted Anywhere in Australia. Therefore, the Month of Dhul Hijjah Will Commence from Thursday, 23rd of July 2020."

[67]Daniel J Schroeder, *Astronomical Optics* (London: Elsevier, 1999).

[68]Australia, "Policy and Procedures: Hilāl Sighting and Decisions."

coordinator, Dr Shabbir, that *hilal* observing must be consistent with the practice done by *Rasulullah* (*SAW*) without optic aid.[69] Therefore, the *Moonsighting Australia* observation is performed by the naked eye only. This is different from Brunei, Nigeria, and Indonesia,[70] which permits the use of optic aid. However, the method used by *Moonsighting Australia* is in line with Thailand's application in deciding on *Ramadhan* and *Shawwal*. *Rukyatul hilāl* is only observed by the naked eye regardless of visibility criteria.[71]

This finding requires further analysis, as the previous discussion showed that Alice Spring, Perth, and Darwin meet the Odeh criteria for *hilal* visibility using optical aid. It means that *hilāl* is invisible in Australia because *Moonsighting Australia* does not use optical instruments. This is confirmed by a report of *hilal* observation by the National Institute of Aeronautics and Space (LAPAN) in Kupang City, which used a telescope (Takahashi FSQ-106ED) and an Astronomy camera (QHY 5L-II-M). The areas are located at 123° 34.77' East and 10° 9.88' South, not too far from Darwin. These two cities were only 2-degree latitudes and 829 kilometers apart.[72] Although the cities are in Zone C of Odeh criteria, they reported two opposing results.

5. Conclusion

This study analyzed the methods, *matla*, time, *hilāl* visibility and resistor factors on Zulhijjah 1441 H determination and made the following conclusions:

1. *Moonsighting* Australia applied *the rukyat* method with the naked eye without optical aid to determine the first hijrah month.
2. *Moonsighting* Australia convinced the *matla* concept of '*wilayat al hukmi,'* only used in Australian territorial regions.
3. *Rukyatul hilāl* is performed every 29th of the current month without considering the conjunction time.
4. The criteria of *hilal* visibility cannot be referenced for consideration at the beginning of the Hijri month.

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[69]Shabbir, Hilāl Monitoring in Australia (*Interview*, 2021).

[70]Siti Arinah Ahmad and Shakir Akram Hassan, "The Role and Effort by Ministry of Religious Affairs of the Republic of Indonesia in Consolidation and Determining the Beginning of the Holy Month of Ramadan and Eid Celebrations in Indonesia," *International Journal of Academic Research and Business and Social Sciences* 7, no. 6 (2017): 968-78; Abdulmajeed Bolade Hassan-Bello, "Sharia and Moon Sighting and Calculation Examining Moon Sighting Controversy in Nigeria," *Al-Ahkām* 30, no. 2 (2020): 215-52, https://doi.org/10.21580/ahkam.2020.30.2.5635; Shahir Akram Hassan, and Mohd Shukri Hanapi, "Standard Operating Procedure (Sop) in Determining the Arrival of Shawwal in Brunei Darussalam," *Social and Humanities Journal* 10, no. 10 (2015): 27-35.

[71]Sulaiman, and Hassan, "The Application of Rukyah and Hisab in Determining the Starting Dates of the Months of Ramadhan and Syawal in Thailand."

[72]"Distance Map Between Kupang and Darwin," www.DistanceCalculator.net, accessed December 23, 2021, https://www.distancecalculator.net/from-kupang-to-darwin.

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